Jeff Ferguson looks at objects' origins to learn about history

Kelsi Anderson / May 3, 2016

Jeff Ferguson sits in his office at the MU Research Reactor. Photo by Kelsi Anderson

Columbia — Jeff Ferguson can't sit still for long. He emanates energy, always searching for something to occupy his mind or his hands.

That energy often funnels into his longtime interest in handcrafted things and human technologies. As an archaeologist, he analyzes artifacts crafted a long time ago in the hopes of finding out more about the people who made them.

Along with Michael Glascock, Ferguson co-directs the MU Research Reactor Archaeometry Lab, which applies chemistry to archaeology to find out where rocks, ceramics and other ancient artifacts came from. Glascock plans to retire in two or three years, at which point Ferguson will take over as director of the lab.

A material's origin is an important question — one that leads to a host of new questions that can help us understand where people came from and how they interacted with the world and with each other. For instance, if a piece of pottery ends up 100 miles from where its materials were sourced, that's evidence of migration or trade between communities.

To trace a material's origin, archaeologists must look at its chemical makeup. In doing that, Ferguson often looks at his favorite material: obsidian.

"I'm fascinated with obsidian use. To me there's nothing more fun than getting data about use of different obsidian sources," Ferguson said.

The volcanic glass forms when lava cools rapidly under the right conditions. It appears most commonly as shiny black stones, but it can also come in other colors. Ferguson said there are roughly 2,000 known obsidian sources around the world.

Obsidian was used by most civilizations that could get it. Though brittle, its shards are far sharper than surgical steel. "When I tell people that, they never believe me," Ferguson said. "It's the sharpest edge you can get anywhere."

Obsidian was useful for hunter-gatherer civilizations in particular, including those in the Southwestern U.S., where a lot of Ferguson's work focuses. With its widespread use, the material is a prime subject for a comprehensive database of obsidian sources, which allows the lab to pinpoint what source an obsidian sample came from by matching chemical fingerprints, or unique patterns that mark the presence of a particular molecule in a sample.

Obsidian will share the same chemical fingerprint as its place of origin, so through identifying those molecules, researchers can trace obsidian-based materials back to their geographic beginnings.

Glascock said obsidian is unique in comparison to many other materials the lab analyzes. "You can analyze the obsidian and by comparing it to the sources you can almost say within 99 percent certainty where it came from," Glascock said. Other materials require guesswork or more information beyond the material's composition.

Pottery is more complicated to trace because it can be modified over time. For example, people would break up pottery and use it to make new pots. With pottery, researchers look at evidence of production, which is the equivalent of geologic source samples that are used in obsidian.

A set of fingerprints can't be traced back to its owner if he or she is not already on file, and it's the same with obsidian and other artifacts. To trace where an obsidian artifact came from, researchers need to match its chemical fingerprint with the fingerprint of an already documented obsidian source. That's why databases like the Archaeometry Lab's obsidian database are vital.

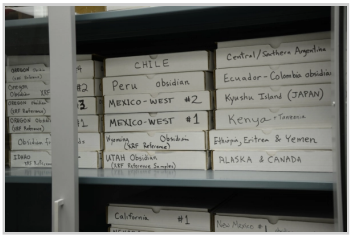
One such researcher to take advantage of the database is Robert Hoard, an MU alumnus and State Archaeologist at the Kansas Historical Society, who was trying to source an obsidian projectile point found at the Massacre Canyon archaeological site in Hitchcock County, Nebraska. He first went to another lab for analysis.

"It was a perfectly acceptable method, perfectly acceptable lab, but the results came up as being unknown," Hoard said. He then turned to the MU Archaeometry Lab, where he had worked in college. The lab was able to do a more precise analysis and matched the artifact as having come from one of the sources in its database, Valle Grande in New Mexico's Jemez Mountains.

"The university research reactor has the capability and the personnel to very accurately ascertain information like this," Hoard said. "They do a good job, in short."

Glascock started the obsidian database in 1982, with its first project analyzing 750 obsidian artifacts sent from Mexico. Gradually, people began sending obsidian from all over the world, and he's watched the lab blossom to a team of a dozen.

Evidence of that scope is seen in the dozens of flat shipping boxes stacked inside a glass case in the Archaeometry Lab. Each one is labeled with the names of far-flung locations: Ecuador, Peru, Chile, Utah. Opening the glass doors, Jeff Ferguson pulls out a box labeled Hokkaido, Japan, and opens it up to show dozens of baggies containing obsidian samples.



Boxes of obsidian samples collected from all over the world sit inside a glass case in the MURR Archaeometry Laboratory. Ferguson says the boxes represent only a small percentage of the lab's entire collection. Photo by Kelsi Anderson.

Ferguson pulls out one of the vials containing powdered pottery that will be analyzed using Neutron Activation Analysis. Photo by Kelsi Anderson

"We have probably the most extensive obsidian source database, both in terms of physical specimens and data of anywhere else in the world," said Ferguson. There are other labs that have databases, but they tend to focus on specific geographic areas.

Analyzing materials

The first step to find a sample's origin is figuring out how best to analyze it.

"I think we have a very unique facility here in the sense that we have all these tools that we have," Glascock said. The Archaeometry Lab has multiple methods of analysis, which helps it stand out from other labs.

The Archaeometry Lab is currently one of the only labs to do neutron activation analysis on archaeological samples, which requires use of MURR's nuclear reactor. Lab workers pop a sample into a pneumatic tube and send it through pipes and into the reactor. Here, neutrons flood the material and cause it to form radioactive isotopes, at which point the material is sent back down to the lab. While the isotopes decay, different elements emit unique gamma rays that are like fingerprints for specific elements.

Another method is X-ray fluorescence, which involves hitting a material with an x-ray, exciting the atoms and causing the material to emit x-rays of its own. Different x-rays are unique to different elements.

Inductively coupled plasma mass spectrometry, a highly sensitive method, works well for analyzing trace elements. The lab can use laser ablation, which focuses a laser onto the material's surface, which releases ionized particles as an aerosol. A more time-consuming process is to use a special microwave oven to digest the material in acids. The particles will then be transported into a mass spectrometer, where elements are identified.

Working with outside research

Ferguson says the lab has analyzed more than 170,000 specimens since 1988. Outside researchers, including graduate students and private contractors, submit specimens from both small and large projects for testing.

Ferguson said that a lot of his job involves helping these other researchers.

"I'm in a unique position here in that we're largely a service group, so a lot of my research is dictated by what other people are interested in collaborating on with us," he said. "I'm still responsible for getting my own grants and doing independent research, but a lot of that is geared towards building the program."

Along with doing analysis, Ferguson also helps researchers like Hoard interpret their research. In March, a group of Texas A&M graduate students traveled to Columbia for a few days to workshop their research with Ferguson and learn how to use the Archaeometry Lab equipment.

Joshua Keene, a graduate student at Texas A&M who studies Great Basin prehistoric stone artifacts, also visited the lab in 2014. Both times he appreciated being able to learn techniques from Ferguson and get help with his research. "He's really one of the very few people in the world who can answer my questions," Keene said.

He was also able to analyze some of the lab's large obsidian collection. "Otherwise I'd have to go out and try to find GPS coordinates and go out in the desert and find my own," he said.

Both trips were funded by the National Science Foundation. Ferguson said the lab uses NSF funding to leverage research projects that wouldn't be possible otherwise. "If it wasn't for the lab, then most of the work we do wouldn't be done. And if it would, it would be vastly more expensive to do."

But what is the bigger importance of all this work that archaeological researchers like Ferguson do?

Ferguson said sometimes the general public might not care about these types of discoveries, that hundreds of years ago a certain group of people migrated here or traded with this other group of people. But in his eyes, making those discoveries build toward generating a larger picture of our past, one that the public does want to know about.

"I used to feel guilty about that, when I couldn't answer that question," Ferguson said. "And now I don't know that that's necessarily our job. Sometimes we don't know what the big questions are until we know what happened begin with…. We don't always know what questions to ask about the past until we know more about it."

Hobbies at home

Ferguson's interest in crafted items extends beyond the office into his home pastimes.

In his 1,200-square-foot workshop at home, dozens of shelves burst at the seams with pottery at various stages of completion, amidst oversized buckets of glaze. In one corner, large piles of wood shavings are swept into a pile around a wood turning lathe, across from painted, handmade beehives.

A seemingly endless supply of obsidian fills in the nooks and crannies.

Along with working with obsidian, Ferguson also taught himself how to flintknap, or craft tools from obsidian or other stones. When the Texas A&M students visited the week before, he invited them to his home, showed them how to flintknap and gave away some samples to use for reference in their own research.

An obsidian projectile point Jeff Ferguson created sits in his office. Photo by Kelsi Anderson.

It was no loss. A heap of obsidian sits in totes in Ferguson's yard; by his estimate, it was once about 10,000 pounds worth. Now he thinks that's down to 5,000 or 6,000.

Ferguson runs a small pottery business out of his workshop. He attends art shows with his work and sells it at local galleries like the Columbia Art League.

Ferguson holds a ball of clay he plans to put on the pottery wheel. Photo by Kelsi Anderson

Ferguson shapes the clay as it spins on the pottery wheel. Photo by Kelsi Anderson

The clay begins to take shape. Photo by Kelsi Anderson

Ferguson shapes the clay. Photo by Kelsi Anderson

The clay begins to take the shape of a bowl. Photo by Kelsi Anderson.

Ferguson uses a tool to smooth out the top of the bowl. Photo by Kelsi Anderson

Ferguson takes a sponge to the nearly completed bowl. Photo by Kelsi Anderson

Ferguson presses a pattern into the bowl's edge. Photo by Kelsi Anderson

Ferguson takes the thrown bowl off of the pottery wheel. Photo by Kelsi Anderson

In his office at the Research Reactor, Ferguson shows off his so-called "rejects" — a blue glazed mug sitting at his desk; a pit-fired vase on the bookshelf. Ferguson also has interest in woodturning, and he owns 30 beehives and about 200 logs on which he grows mushrooms.

The serial hobbyist's other, shorter-lived interests include gourd carving and quilting, and he builds and sells beehives and wooden bowls. The funds usually go straight back into supporting his hobbies.

Ferguson shows the speckling pattern that appears in pottery when manganese is mixed into the clay. Photo by Kelsi Anderson

There's something inexplicably fascinating to him about circles and things that spin, and so much of his work is round. "If I could make beehives round, I'd probably do it," he said.

In addition to his work life and extracurricular activities, Ferguson spends time with his wife and four kids. He said it's when the kids go to bed that he does most of his free-time activities. "If I'm not with them, that's what I'm doing," Ferguson said.

"If I didn't do so much, I probably would have more time for research," he joked. He lamented that this year's Art in The Park is the same week he's attending a conference in Italy.

"He's got his hands full," Glascock said. "It shows an amazing ability for him to be able to handle the work that he does here and still have a nice home life and hobbies."

Ferguson said he's been interested in craft production since childhood, always building or making something.

"I think that's part of the draw to archaeology," Ferguson said. "That study of technology, trying to understand how and why people make things, use things, break things, discard things.

"To me, it's fascinating. To be able to study it — to be able to do it."

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